PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-090460

(43)Date of publication of application : 31.03.2000

(51)Int.Cl. G11B 7/09
C23C 18/50
C23C 18/52
F16C 29/02
G11B 7/135

(21)Application number : 10-259521

(22)Date of filing : 14.09.1998

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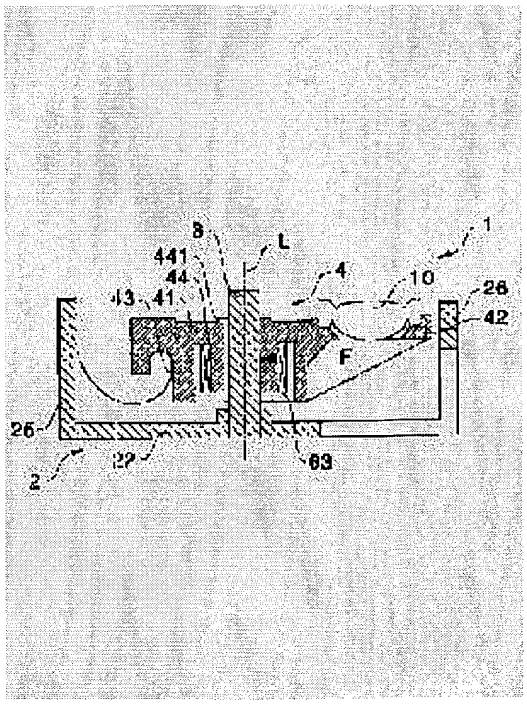
(54) OBJECTIVE LENS DRIVING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an objective lens driving device in which the sliding characteristic between a lens holder and a sliding shaft is made better and higher order resonance of the lens holder is prevented.

SOLUTION: A lens holder 4 of an objective lens driving device 1 is formed by liquid crystal resin including carbon fibers to obtain high rigidity so as to prevent the occurrence of resonance. On the other hand, a sliding shaft to be inserted into a shaft hole 441 formed on the lens holder 4 is formed by a stainless steel base material whose outer peripheral surface is plated with nickel-phosphorus with dispersed PTFE. Thus, the plated layer has a higher hardness, is superior in lubricity and therefore, the layer has a high sliding characteristic against the lens holder 4 having carbon fibers. Since the base material is formed by stainless steel, no rust is formed on the base material even though water is penetrated through the pin holes made on the plated layer.



LEGAL STATUS

[Date of request for examination]	29.01.2002
[Date of sending the examiner's decision of rejection]	09.12.2003
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	2004-00503
[Date of requesting appeal against examiner's decision of rejection]	07.01.2004
[Date of extinction of right]	

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CLAIMS

[Claim(s)]
[Claim 1] While said lens holder is formed with the liquid-crystal resin containing a carbon fiber in the objective lens driving gear which has the lens holder which held the objective lens while having the boss, and the sliding shaft which was inserted in said boss and supported said lens holder pivotable [to the circumference of an axis] movable in the direction of an axis, for the nickel-Lynn plating with which polytetrafluoroethylene was distributed, said sliding shaft is an objective lens driving gear characterized by to be given to the peripheral face of a metal base material.
[Claim 2] It is the objective lens driving gear characterized by forming the base material of said sliding shaft with stainless steel in claim 1.
[Claim 3] It is the objective lens driving gear characterized by being formed with the liquid crystal resin with which said lens holder contained the carbon fiber in claims 1 or 2 10 % of the weight to 40% of the weight.
[Claim 4] The objective lens driving gear characterized by setting they being [any / claim 1 thru/or / of 3], and performing nickel-Lynn plating which made the peripheral face of the base material of said sliding shaft distribute polytetrafluoroethylene 3 % of the weight to 11% of the weight.
[Claim 5] It is the objective lens driving gear which it sets they to be [any / claim 1 thru/or / of 4], and heat treatment is performed to the base material of said sliding shaft, and is characterized by Vickers hardness number Hv of the peripheral face of the base material concerned having become 500 or more.
[Claim 6] The surface roughness of nickel-Lynn plating which it sets they to be [any / claim 1 thru/or / of 5], and the surface roughness of the peripheral face of the base material of said sliding shaft is [surface roughness] 0.4 micrometers or less, and distributed the polytetrafluoroethylene currently formed in the peripheral face of the base material of said sliding shaft is an objective lens driving gear characterized by being 1.5 micrometers or less.
[Claim 7] The thickness of the nickel-Lynn plating which distributed the polytetrafluoroethylene which sets they to be [any / claim 1 thru/or / of 6], and is formed in the peripheral face of the base material of said sliding shaft is an objective lens driving gear characterized by being 1 micrometer - 4 micrometers.
[Claim 8] Vickers hardness number Hv of nickel-Lynn plating which distributed the polytetrafluoroethylene which sets they to be [any / claim 1 thru/or / of 7], and is formed in the peripheral face of the base material of said sliding shaft is an objective lens driving gear characterized by being 500-600.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to record of optical recording disks, such as CD (compact disk) and DVD (digital video disc), and the objective lens driving gear of the optical pickup which performs playback. It is related with the technique for raising the sliding property between the sliding shafts which support the lens holder holding an objective lens, and this lens holder in more detail.
[0002]
[Description of the Prior Art] There is a thing of an axial sliding mold which has the lens holder which held the objective lens as record of optical recording disks, such as CD and DVD, and an objective lens driving gear of an optical pickup used for playback while having the boss, and the sliding shaft which it was inserted in the boss and supported pivotable [to the circumference of an axis] movable in the direction of an axis.
[0003] In the objective lens driving gear of an axial sliding mold, in order to raise the sliding nature between the inner skin of a boss and the peripheral faces of a sliding shaft which were formed in the lens holder, the following measures are taken conventionally.
[0004] First, carrying out spray painting of the coating which distributed polytetrafluoroethylene (henceforth PTFE) to polyamidoimide (henceforth PAI) to the peripheral face of a sliding shaft as a general approach is performed.
[0005] Moreover, the objective lens driving gear which raised the sliding property is indicated by attaching in JP,5-89497,A the metal sleeve which forms a boss in a lens holder, and performing nickel-Lynn plating which made the inner skin of this sleeve distribute PTFE.
[0006] Furthermore, the objective lens driving gear which raised the sliding property is indicated by performing nickel-Lynn plating which made the peripheral face of a metal sliding shaft distribute PTFE to JP,6-325389,A.
[0007] The objective lens driving gear which raised the sliding property is indicated by forming a lens holder in JP,63-130916,U by resin excellent in lubricity and elasticity further again.
[0008]
[Problem(s) to be Solved by the Invention] However, the conventional approach currently performed in order to improve a sliding property has the respectively following troubles.
[0009] First, by the approach of carrying out spray painting of the coating to the peripheral face of a sliding shaft, since it is difficult to make a coating adhere to the front face of a sliding shaft at homogeneity, after paint, a painted surface must be ground and roundness and surface roughness must be adjusted. However, since a painted surface is comparatively soft, even if it grinds, it is difficult to adjust even to roundness or a precision aiming at surface roughness. Therefore, there is a problem that a sliding property cannot be raised enough.
[0010] Next, by the approach of performing nickel-Lynn plating which made the inner skin of a boss, or the peripheral face of a sliding shaft distributing PTFE, a pinhole will occur on a plating front face. Therefore, since moisture permeates from a pinhole, rust is generated on the substrate of a boss, or the

substrate of a sliding shaft, and the float of plating and exfoliation occur. When such a thing arises, there is a problem that a sliding property will deteriorate.
[0011] Next, by the approach of forming a lens holder by resin excellent in lubricity and elasticity, since the rigidity of a lens holder becomes low, it becomes easy to generate high order resonance of a lens holder. Therefore, there is a problem which is said when it comes to the hindrance to improvement in the speed of a lens-holder drive.
[0012] In view of the above problem, the technical problem of this invention can raise the sliding property between a lens holder and a sliding shaft, and is to offer the objective lens driving gear which can prevent high order resonance of a lens holder moreover.
[0013]
[Means for Solving the Problem] The lens holder which held the objective lens while this invention was equipped with the boss, in order to solve the above-mentioned technical problem, In the objective lens driving gear which has the sliding shaft which was inserted in said boss and supported said lens holder pivotable [to the circumference of an axis] movable in the direction of an axis said lens holder While being formed with the liquid crystal resin containing a carbon fiber, said sliding shaft is characterized by performing nickel-Lynn plating which distributed PTFE to the peripheral face of a metal base material.
[0014] In this invention, since the lens holder is formed with the liquid crystal resin containing a carbon fiber, a rigid high lens holder can be formed. Therefore, resonance can be prevented even if it attains improvement in the speed of a drive of a lens holder. However, although the carbon fiber is effective in raising the rigidity of a lens holder, there is a fault that the surface roughness of a lens holder is large. For this reason, if it remains as it is, since the surface roughness of the inner skin of a boss is large in a lens holder, the sliding property of the inner skin of a boss and the peripheral face of a sliding shaft falls. However, in this invention, nickel-Lynn plating which distributed PTFE is performed to the peripheral face of a sliding shaft. Since it is easy to control thickness compared with what applied the coating which made the conventional PAI distribute PTFE with such plating, the thing of roundness or the level aiming at surface roughness can be obtained. Moreover, since nickel serves as the base with such plating, compared with what applied the coating which made the conventional PAI distribute PTFE, it is hard. Therefore, even if the carbon fiber has projected from the inner skin of a boss, a blemish is not attached to plating. Furthermore, since PTFE is distributed by plating, lubricity is also high. So, even if the surface roughness of the inner skin of a boss is somewhat large, a high sliding property is securable.
[0015] As for the base material of said sliding shaft, in this invention, being formed with stainless steel is desirable. That is, in a sliding shaft, if the substrate of nickel-Lynn plating is used as stainless steel, since the corrosion resistance of the base material of ******** can be raised, even if moisture should permeate the direction of a substrate from the pinhole of the nickel-Lynn plating which has covered the sliding shaft, rust is not generated in a base material. Therefore, in the plating which has covered the base material, since it can prevent that the float resulting from the rust of a substrate and peeling arise, the sliding property between the inner skin of a boss is maintainable in the good condition.
[0016] In this invention, said lens holder is formed with the liquid crystal resin which contained the carbon fiber 10 % of the weight to 40% of the weight. Moreover, nickel-Lynn plating which distributed PTFE 3 % of the weight to 11% of the weight is performed to the peripheral face of the base material of said sliding shaft.
[0017] In this invention, heat treatment is performed to the base material of said sliding shaft, and, as for Vickers hardness number Hv of the peripheral face of the base material concerned, it is desirable to have become 500 or more. Thus, if the degree of hardness of the peripheral face of the base material of a sliding shaft is raised, since plating thickness can be made thin and roundness and surface roughness can be improved, the sliding property and dependability of a sliding shaft can be improved. For example, even when the stress by the lens holder is applied to a sliding shaft, it can prevent that a sleeve trace occurs in the peripheral face of a sliding shaft.
[0018] Moreover, in order to secure sliding property sufficient between the bosses formed in the lens holder, it is desirable to set to 1.5 micrometers or less surface roughness of nickel-Lynn plating which distributed wrap PTFE for the peripheral face of the base material of a sliding shaft. Here, the surface

roughness of nickel-Lynn plating which distributed PTFE is influenced of the surface roughness of the peripheral face of a base material. Then, in this invention, surface roughness of nickel-Lynn plating which distributed PTFE currently formed in the peripheral face of the base material of 0.4 micrometers or less, then said sliding shaft in the surface roughness of the peripheral face of the base material of said sliding shaft can be set to 1.5 micrometers or less.

[0019] As for the thickness of the nickel-Lynn plating which distributed the polytetrafluoroethylene currently formed in the peripheral face of the base material of said sliding shaft, in this invention, it is desirable that it is 1 micrometer - 4 micrometers. Thus, since there are 1 micrometers or more of thickness of plating at least when constituted, in order to raise a sliding property in plating, sufficient PTFE particle can be held. Moreover, since the thickness of plating is 4 micrometers or less, surface roughness of plating can be made small. Therefore, a high sliding property is securable.

[0020] As for Vickers hardness number Hv of nickel-Lynn plating which distributed the polytetrafluoroethylene currently formed in the peripheral face of the base material of said sliding shaft, in this invention, it is desirable that it is 500-600. Thus, or more with 500, if constituted, since Vickers hardness number Hv of plating is high, it can raise a sliding property. Moreover, Vickers hardness number Hv of plating does not damage 600 or less and the inner skin of the boss formed in the lens holder since it was not too high. What is necessary is to perform this plating to the peripheral face of the base material of a sliding shaft, and just to heat-treat after an appropriate time, in order to form the nickel-Lynn plating which distributed PTFE of such hardness.

[0021]

[Embodiment of the Invention] With reference to a drawing, the gestalt of operation of the objective lens driving gear of this invention is explained.

[0022] (Whole configuration) Drawing 1 is the top view showing the objective lens driving gear which applied this invention. Moreover, drawing 2 is a sectional view in the I-I' line in drawing 1 . As shown in drawing 1 and drawing 2 , the objective lens driving gear 1 has the lens holder 4 holding an objective lens 10, and the holder supporter material 2 which supported this lens holder 4.

[0023] The holder supporter material 2 is equipped with the bottom wall 22 of an abbreviation rectangle, and the side attachment walls 23-26 which started from the neighborhood of a bottom wall 22 perpendicularly. Adhesion immobilization of the tracking drive magnets 51 and 52 by which polarization magnetization was carried out in the hoop direction is carried out at the medial surface of the side attachment walls 23 and 24 mutually prolonged in parallel among these side attachment walls 23-26, respectively.

[0024] Moreover, from the bottom wall 22, the walls 27 and 28 of the pair prolonged in parallel to the side attachment walls 23 and 34 with which the tracking drive magnets 51 and 52 were attached are started. Adhesion immobilization of the focusing drive magnets 61 and 62 to which the inside is turned is carried out in the field magnetized by the single electrode at the medial surface of walls 27 and 28, respectively.

[0025] Furthermore, the sliding shaft 3 is being fixed to the center section of the bottom wall 22 inserted with the walls 27 and 28 of a pair. The lens holder 4 is supported by this sliding shaft 3.

[0026] The lens holder 4 is equipped with the cylinder-like drum section 43 and the bearing 44 of the shape of a cylinder formed the wrap top plate 41 and inside the drum section 43 in the drum section 43 bottom. The lens installation section 42 thinly jutted out towards an outside is formed in the top plate 41, and adhesion immobilization of the objective lens 10 is carried out on this. Moreover, on both sides of the bearing 44, the openings 411 and 412 of a pair are formed in the location of both sides among top plates 41.

[0027] The sliding shaft 3 which stood straight from the bottom wall 22 of the holder supporter material 2 is inserted in the boss 441 formed in the bearing 44 of this lens holder 4. Moreover, inside the openings 411 and 412 of the pair formed in the top plate 41 of a lens holder 4, the walls 27 and 28 of the pair which stood straight from the bottom wall 22 of the holder supporter material 2 are inserted, respectively. Therefore, the bearing 44 of a lens holder 4 is arranged among the focusing drive magnets 61 and 62 attached in the walls 27 and 28 of a pair.

[0028] The focusing drive coil 63 is twisted around the bearing 44 of a lens holder 4. Between this focusing drive coil 63 and the focusing drive magnets 61 and 62, the focusing MAG drive circuit to which a lens holder 4 is moved up and down in accordance with the sliding shaft 3 is constituted.
[0029] Moreover, the tracking drive coils 53 and 54 of a pair are attached in the peripheral face of the drum section 43 of a lens holder 4 so that face to face may be stood against the tracking drive magnets 51 and 52. Between these tracking drive coils 53 and 54 and the tracking drive magnets 51 and 52, the tracking MAG drive circuit which rotates a lens holder 4 around the sliding shaft 3 is constituted.
[0030] The magnetic pieces 8 and 9 of a pair are also pasted up on the location which the tracking drive coils 53 and 54 of a pair pasted up among the peripheral faces of the drum section 43 of a lens holder 4. The center-valve-position maintenance means for holding a lens holder 4 in a center valve position to the holder supporter material 2 is constituted by the magnetic circuit between the magnetic pieces 8 and 9 of this pair, and the tracking drive magnets 51 and 52 of a pair. That is, magnetic attraction of the magnetic pieces 8 and 9 of a pair is carried out to the magnetic center position of the tracking drive magnets 51 and 52 of a pair. Therefore, when not supplying the current to the focusing drive coil 61 and the tracking drive coils 53 and 54, a lens holder 4 is held in the center valve position (center section of the direction of an axis of the sliding shaft 3) of the direction of focusing, and the center valve position (location where the tracking drive coils 53 and 54 stand face to face against the front of the tracking drive magnets 51 and 52) of the direction of tracking.
[0031] Moreover, the core of the magnetic pieces 8 and 9 of a pair is mutually shifted from the location which stands face to face against the magnetic core of the tracking drive magnets 51 and 52 of a pair to the circumference of the medial-axis line L of a boss 441 towards the direction where only the same include angle alpha approaches mutually. Therefore, since the magnetic-attraction force F1 and F2 of the tracking drive magnets 51 and 52 which work to the magnetic pieces 8 and 9 of a pair acts aslant towards the magnetic core of the tracking drive magnets 51 and 52, the lateral pressure F which turns and forces a lens holder 4 on the sliding shaft 3 according to resultant force of these magnetic-attraction force F1 and F2 generates it, respectively. Therefore, since the side on which lateral pressure F is acting among the inner skin of the boss 441 formed in the lens holder 4 has always stuck to the peripheral face of the sliding shaft 3, it is prevented with [of the lens holder 4 resulting from the path clearance between the inner skin of a boss 441, and the peripheral face of the sliding shaft 3] backlash.
[0032] (A lens holder 4 and sliding shaft 3) Here, the lens holder 4 is formed with the liquid crystal resin which contained the carbon fiber 10 % of the weight to 40% of the weight, in order to raise the rigidity and to prevent resonance. For this reason, the flexural modulus of a lens holder 4 is 35000 or more MPas in the part with a thickness of 8mm or more. However, although the carbon fiber is effective in order to raise the rigidity of a lens holder 4, there is a fault that the surface roughness of a lens holder 4 becomes large. Therefore, if it remains as it is, since the surface roughness of the inner skin of the boss 441 formed in the lens holder 4 is large, the sliding property of the inner skin of a boss 441 and the peripheral face of the sliding shaft 3 falls. So, with this gestalt, the sliding shaft 3 is formed so that it may explain below.
[0033] Drawing 3 is the sectional view of the sliding shaft 3. As shown in drawing 3 , the sliding shaft 3 has the round bar-like base material 31 and the plating layer 33 by which the laminating was carried out to the peripheral face 32 of this base material 31.
[0034] A base material 31 is formed with stainless steel. This base material 31 is processed so that the surface roughness of a peripheral face 32 may be set to 0.4 micrometers or less. Moreover, heat treatment is performed to a base material 31, and let surface hardness of the peripheral face 32 be 500 or more Vickers hardness numbers Hv.
[0035] The plating layer 33 is the nickel-Lynn plating which carried out distribution of the polytetrafluoroethylene (henceforth PTFE) 3 % of the weight to 11% of the weight (17 volume % - 27 volume %). The thickness dimension t of this plating layer 33 is 1 micrometer - 4 micrometers. Moreover, the surface roughness of the peripheral face 34 of the plating layer 33 is 1.5 micrometers or less. The surface roughness of this plating layer 33 is influenced by the surface roughness of a base material 31. That is, since surface roughness of the peripheral face 32 of a base material 31 is set to 0.4

micrometers or less, if the thickness dimension of the plating layer 33 which carries out a laminating to the peripheral face 32 of this base material 31 is 4 micrometers or less, surface roughness of the peripheral face 34 of the plating layer 33 can be set to 1.5 micrometers or less. Furthermore, heat treatment is performed to the plating layer 33. Consequently, the surface hardness of the peripheral face 34 of the plating layer 33 serves as Vickers hardness number Hv 550 [about].

[0036] Such a plating layer 33 of the sliding shaft 3 can be formed so that it may explain below. Namely, as shown in drawing 4 , it rinses by performing preliminary cleaning of the base material 31 with which heat treatment was performed beforehand (step ST 1) (step ST 2). Next, it rinses by performing boiling cleaning of a base material 31 (step ST 3) (step ST 4). Next, it rinses by performing electrolytic degreasing of a base material 31 (step ST 5) (step ST 6). Next, it rinses by performing pickling of a base material 31 (step ST 7) (step ST 8).

[0037] Thus, nickel strike plating is performed and (step ST 9) rinsed to the peripheral face 32 of the washed base material 31 (step ST 10). This is for raising the adhesion of the nickel-Lynn plating which distributed the following PTFE.

[0038] Next, non-electrolyzed nickel-Lynn plating which made the peripheral face 32 of a base material 31 distribute PTFE is performed (step ST 11). Consequently, the peripheral face 32 of a base material 3 1 is covered in the plating layer 33.

[0039] After an appropriate time, centrifugal hydroextraction of rinsing (step ST 12), hot water rinsing (step ST 13), and the pure-water washing (step ST 14) is performed and carried out (step ST 15).

[0040] At the end, it heat-treats (step ST 16) and the surface hardness of the plating layer 33 is raised.

[0041] (Effectiveness of this gestalt) In the objective lens driving gear 1 of this gestalt, since the lens holder 4 is formed with the liquid crystal resin containing a carbon fiber, even if it attains improvement in the speed of a drive of a lens holder 4, the rigid high lens holder 4 which can prevent resonance can be formed.

[0042] Moreover, the plating layer 33 which becomes the peripheral face 32 of the base material 31 of the sliding shaft 3 from the nickel-Lynn plating which distributed PTFE is formed so that the surface roughness of the inner skin of the boss 441 formed in the lens holder 4 becomes large by the carbon fiber added in order to raise the rigidity of a lens holder 4 and the fault that the sliding property between the peripheral faces of the sliding shaft 3 deteriorates can be compensated. If it is such a plating layer 33, since it will be easy to control thickness compared with what applied the coating which made the conventional PAI distribute PTFE, the thing of roundness or the level aiming at surface roughness can be obtained. Moreover, since nickel serves as the base, this plating layer 33 has a high degree of hardness compared with the coating which made the conventional polyamidoimide distribute PTFE. Therefore, even if the carbon fiber has projected from the inner skin of a boss 441, a flaw is not attached to the plating layer 33. Furthermore, since PTFE is distributed by the plating layer 33, lubricity is high. So, even if the surface roughness of a boss 441 is large, the sliding property between the peripheral face of the sliding shaft 3 and the inner skin of a boss 441 can be raised.

[0043] Moreover, since the base material 31 of the sliding shaft 3 is formed with stainless steel, its corrosion resistance of a base material 31 is high. Therefore, even if moisture should permeate the direction of a substrate from the pinhole of the plating layer 33 which has covered the mother agent 31 of the sliding shaft 3, rust is not generated in a base material 31. Therefore, in the plating layer 33 which has covered the base material 31, since it can prevent that the float resulting from the rust of a substrate and peeling arise, the sliding property between the inner skin of a boss 441 is maintainable in the good condition.

[0044] Furthermore, since heat treatment is performed to the base material 31 of the sliding shaft 3, 500 or more have been Vickers hardness number Hv of the peripheral face 32 of a base material 31. Therefore, since the degree of hardness of the peripheral face 32 of the base material 31 of the sliding shaft 3 is high, even if it makes thickness of the plating layer 33 thin, the dependability of the sliding shaft 3 is maintainable. Temporarily, if the plating layer 33 is thin, when stress will concentrate on one place of the peripheral face of the sliding shaft 3 by the lateral pressure F given to the lens holder 4 in the condition that the peripheral face 32 of a base material 31 is soft, since the stress is applied to a base

material 31 through the plating layer 33 and a sleeve trace is attached to the peripheral face 32 of a base material 31, the surface roughness of the plating layer 33 becomes large. However, with this gestalt, since the degree of hardness of the peripheral face 32 of a base material 31 is high, even if the plating layer 33 is thin, it can prevent that a sleeve trace occurs. Therefore, the dependability between the peripheral face (peripheral face 34 of the plating layer 33) of the sliding shaft 3 and the inner skin of a boss 441 is maintainable.

[0045] Moreover, since surface roughness of the peripheral face 32 of a base material 31 is set to 0.4 micrometers or less, surface roughness of the plating layer 33 can be set to 1.5 micrometers or less. the surface roughness of the plating layer 33 is alike to this extent, and if small, sliding property sufficient between the inner skin of a boss 441 is securable.

[0046] Furthermore, since the thickness dimension t of the plating layer 33 is at least 1 micrometers or more, in order to raise a sliding property in the plating layer 33, sufficient PTFE particle can be held. Moreover, since it is 4 micrometers or less, if the thickness dimension of the plating layer 33 has the small surface roughness of the peripheral face 32 of a base material 31 as described above, it is influenced by it and can make surface roughness of the plating layer 33 small. Therefore, a high sliding property is securable.

[0047] Since heat treatment is performed to the plating layer 33, Vickers hardness number Hv of the peripheral face 34 of the plating layer 33 is high or more with 500 further again. Therefore, even if the peripheral face 34 of the plating layer 33 slides with the lens holder 4 by which the carbon fiber was added, it does not get damaged. Moreover, even if it heat-treats in the plating layer 33, Vickers hardness number Hv of the plating layer 33 is not too so high as 600 or less. Therefore, inner skin of the boss 441 formed in the lens holder 4 is not damaged. So, since neither the peripheral face of the sliding shaft 3 nor the inner skin of a boss 441 gets damaged, a high sliding property is securable.

[0048] (Gestalt of other operations) In addition, the plating layer 33 given to the peripheral face 32 of the base material 31 of the sliding shaft 3 can also be formed as follows. Namely, as shown in drawing 5 , it rinses by performing cleaning washing of the base material 31 with which heat treatment was performed beforehand (step ST 21) (step ST 22). Next, it rinses by performing activation (acid cleaning) of a base material 31 (step ST 23) (step ST 24). Thus, nickel strike plating is performed and (step ST 27) rinsed to the peripheral face 32 of the washed base material 31 (step ST 28). Next, non-electrolyzed nickel-Lynn plating which made the peripheral face 32 of a base material 31 distribute PTFE is performed (step ST 29). Consequently, the peripheral face 32 of a base material 31 is covered in the plating layer 33. After an appropriate time, centrifugal hydroextraction of rinsing (step ST 30) and the pure-water washing (step ST 31) is performed and carried out (step ST 32). At the end, it heat-treats (step ST 33) and the surface hardness of the plating layer 33 is raised.

[0049] Moreover, although the plating layer 33 is formed with nonelectrolytic plating with the above-mentioned gestalt, electrolysis plating may be used as long as it is the nickel-Lynn plating which distributed PTFE.

[0050]

[Effect of the Invention] As explained above, since the lens holder is formed with the liquid crystal resin containing a carbon fiber, even if it attains improvement in the speed of a lens-holder drive, with the objective lens driving gear of this invention, the rigid high lens holder which can prevent resonance can be formed. On the other hand, a sliding shaft can secure a high sliding property, even if the surface roughness of boss inner skin gets worse by having made the lens holder distribute a carbon fiber, since nickel-Lynn plating which made the peripheral face of a base material distribute PTFE was performed.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to record of optical recording disks, such as CD (compact disk) and DVD (digital video disc), and the objective lens driving gear of the optical pickup which performs playback. It is related with the technique for raising the sliding property between the sliding shafts which support the lens holder holding an objective lens, and this lens holder in more detail.

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PRIOR ART

[Description of the Prior Art] There is a thing of an axial sliding mold which has the lens holder which held the objective lens as record of optical recording disks, such as CD and DVD, and an objective lens driving gear of an optical pickup used for playback while having the boss, and the sliding shaft which it was inserted in the boss and supported pivotable [to the circumference of an axis] movable in the direction of an axis.

[0003] In the objective lens driving gear of an axial sliding mold, in order to raise the sliding nature between the inner skin of a boss and the peripheral faces of a sliding shaft which were formed in the lens holder, the following measures are taken conventionally.

[0004] First, carrying out spray painting of the coating which distributed polytetrafluoroethylene (henceforth PTFE) to polyamidoimide (henceforth PAI) to the peripheral face of a sliding shaft as a general approach is performed.

[0005] Moreover, the objective lens driving gear which raised the sliding property is indicated by attaching in JP,5-89497,A the metal sleeve which forms a boss in a lens holder, and performing nickel-Lynn plating which made the inner skin of this sleeve distribute PTFE.

[0006] Furthermore, the objective lens driving gear which raised the sliding property is indicated by performing nickel-Lynn plating which made the peripheral face of a metal sliding shaft distribute PTFE to JP,6-325389,A.

[0007] The objective lens driving gear which raised the sliding property is indicated by forming a lens holder in JP,63-130916,U by resin excellent in lubricity and elasticity further again.

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EFFECT OF THE INVENTION

(Effectiveness of this gestalt) In the objective lens driving gear 1 of this gestalt, since the lens holder 4 is formed with the liquid crystal resin containing a carbon fiber, even if it attains improvement in the speed of a drive of a lens holder 4, the rigid high lens holder 4 which can prevent resonance can be formed.
[0042] Moreover, the plating layer 33 which becomes the peripheral face 32 of the base material 31 of the sliding shaft 3 from the nickel-Lynn plating which distributed PTFE is formed so that the surface roughness of the inner skin of the boss 441 formed in the lens holder 4 becomes large by the carbon fiber added in order to raise the rigidity of a lens holder 4 and the fault that the sliding property between the peripheral faces of the sliding shaft 3 deteriorates can be compensated. If it is such a plating layer 33, since it will be easy to control thickness compared with what applied the coating which made the conventional PAI distribute PTFE, the thing of roundness or the level aiming at surface roughness can be obtained. Moreover, since nickel serves as the base, this plating layer 33 has a high degree of hardness compared with the coating which made the conventional polyamidoimide distribute PTFE. Therefore, even if the carbon fiber has projected from the inner skin of a boss 441, a flaw is not attached to the plating layer 33. Furthermore, since PTFE is distributed by the plating layer 33, lubricity is high. So, even if the surface roughness of a boss 441 is large, the sliding property between the peripheral face of the sliding shaft 3 and the inner skin of a boss 441 can be raised.
[0043] Moreover, since the base material 31 of the sliding shaft 3 is formed with stainless steel, its corrosion resistance of a base material 31 is high. Therefore, even if moisture should permeate the direction of a substrate from the pinhole of the plating layer 33 which has covered the mother agent 31 of the sliding shaft 3, rust is not generated in a base material 31. Therefore, in the plating layer 33 which has covered the base material 31, since it can prevent that the float resulting from the rust of a substrate and peeling arise, the sliding property between the inner skin of a boss 441 is maintainable in the good condition.
[0044] Furthermore, since heat treatment is performed to the base material 31 of the sliding shaft 3, 500 or more have been Vickers hardness number Hv of the peripheral face 32 of a base material 31. Therefore, since the degree of hardness of the peripheral face 32 of the base material 31 of the sliding shaft 3 is high, even if it makes thickness of the plating layer 33 thin, the dependability of the sliding shaft 3 is maintainable. Temporarily, if the plating layer 33 is thin, when stress will concentrate on one place of the peripheral face of the sliding shaft 3 by the lateral pressure F given to the lens holder 4 in the condition that the peripheral face 32 of a base material 31 is soft, since the stress is applied to a base material 31 through the plating layer 33 and a sleeve trace is attached to the peripheral face 32 of a base material 31, the surface roughness of the plating layer 33 becomes large. However, with this gestalt, since the degree of hardness of the peripheral face 32 of a base material 31 is high, even if the plating layer 33 is thin, it can prevent that a sleeve trace occurs. Therefore, the dependability between the peripheral face (peripheral face 34 of the plating layer 33) of the sliding shaft 3 and the inner skin of a boss 441 is maintainable.
[0045] Moreover, since surface roughness of the peripheral face 32 of a base material 31 is set to 0.4 micrometers or less, surface roughness of the plating layer 33 can be set to 1.5 micrometers or less. the

surface roughness of the plating layer 33 is alike to this extent, and if small, sliding property sufficient between the inner skin of a boss 441 is securable.

[0046] Furthermore, since the thickness dimension t of the plating layer 33 is at least 1 micrometers or more, in order to raise a sliding property in the plating layer 33, sufficient PTFE particle can be held. Moreover, since it is 4 micrometers or less, if the thickness dimension of the plating layer 33 has the small surface roughness of the peripheral face 32 of a base material 31 as described above, it is influenced by it and can make surface roughness of the plating layer 33 small. Therefore, a high sliding property is securable.

[0047] Since heat treatment is performed to the plating layer 33, Vickers hardness number Hv of the peripheral face 34 of the plating layer 33 is high or more with 500 further again. Therefore, even if the peripheral face 34 of the plating layer 33 slides with the lens holder 4 by which the carbon fiber was added, it does not get damaged. Moreover, even if it heat-treats in the plating layer 33, Vickers hardness number Hv of the plating layer 33 is not too so high as 600 or less. Therefore, inner skin of the boss 441 formed in the lens holder 4 is not damaged. So, since neither the peripheral face of the sliding shaft 3 nor the inner skin of a boss 441 gets damaged, a high sliding property is securable.

[0048] (Gestalt of other operations) In addition, the plating layer 33 given to the peripheral face 32 of the base material 31 of the sliding shaft 3 can also be formed as follows. Namely, as shown in drawing 5 , it rinses by performing cleaning washing of the base material 31 with which heat treatment was performed beforehand (step ST 21) (step ST 22). Next, it rinses by performing activation (acid cleaning) of a base material 31 (step ST 23) (step ST 24). Thus, nickel strike plating is performed and (step ST 27) rinsed to the peripheral face 32 of the washed base material 31 (step ST 28). Next, non-electrolyzed nickel-Lynn plating which made the peripheral face 32 of a base material 31 distribute PTFE is performed (step ST 29). Consequently, the peripheral face 32 of a base material 31 is covered in the plating layer 33. After an appropriate time, centrifugal hydroextraction of rinsing (step ST 30) and the pure-water washing (step ST 31) is performed and carried out (step ST 32). At the end, it heat-treats (step ST 33) and the surface hardness of the plating layer 33 is raised.

[0049] Moreover, although the plating layer 33 is formed with nonelectrolytic plating with the above-mentioned gestalt, electrolysis plating may be used as long as it is the nickel-Lynn plating which distributed PTFE.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the conventional approach currently performed in order to improve a sliding property has the respectively following troubles.
[0009] First, by the approach of carrying out spray painting of the coating to the peripheral face of a sliding shaft, since it is difficult to make a coating adhere to the front face of a sliding shaft at homogeneity, after paint, a painted surface must be ground and roundness and surface roughness must be adjusted. However, since a painted surface is comparatively soft, even if it grinds, it is difficult to adjust even to roundness or a precision aiming at surface roughness. Therefore, there is a problem that a sliding property cannot be raised enough.
[0010] Next, by the approach of performing nickel-Lynn plating which made the inner skin of a boss, or the peripheral face of a sliding shaft distributing PTFE, a pinhole will occur on a plating front face. Therefore, since moisture permeates from a pinhole, rust is generated on the substrate of a boss, or the substrate of a sliding shaft, and the float of plating and exfoliation occur. When such a thing arises, there is a problem that a sliding property will deteriorate.
[0011] Next, by the approach of forming a lens holder by resin excellent in lubricity and elasticity, since the rigidity of a lens holder becomes low, it becomes easy to generate high order resonance of a lens holder. Therefore, there is a problem which is said when it comes to the hindrance to improvement in the speed of a lens-holder drive.
[0012] In view of the above problem, the technical problem of this invention can raise the sliding property between a lens holder and a sliding shaft, and is to offer the objective lens driving gear which can prevent high order resonance of a lens holder moreover.

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MEANS

[Means for Solving the Problem] The lens holder which held the objective lens while this invention was equipped with the boss, in order to solve the above-mentioned technical problem, In the objective lens driving gear which has the sliding shaft which was inserted in said boss and supported said lens holder pivotable [to the circumference of an axis] movable in the direction of an axis said lens holder While being formed with the liquid crystal resin containing a carbon fiber, said sliding shaft is characterized by performing nickel-Lynn plating which distributed PTFE to the peripheral face of a metal base material.
[0014] In this invention, since the lens holder is formed with the liquid crystal resin containing a carbon fiber, a rigid high lens holder can be formed. Therefore, resonance can be prevented even if it attains improvement in the speed of a drive of a lens holder. However, although the carbon fiber is effective in raising the rigidity of a lens holder, there is a fault that the surface roughness of a lens holder is large. For this reason, if it remains as it is, since the surface roughness of the inner skin of a boss is large in a lens holder, the sliding property of the inner skin of a boss and the peripheral face of a sliding shaft falls. However, in this invention, nickel-Lynn plating which distributed PTFE is performed to the peripheral face of a sliding shaft. Since it is easy to control thickness compared with what applied the coating which made the conventional PAI distribute PTFE with such plating, the thing of roundness or the level aiming at surface roughness can be obtained. Moreover, since nickel serves as the base with such plating, compared with what applied the coating which made the conventional PAI distribute PTFE, it is hard. Therefore, even if the carbon fiber has projected from the inner skin of a boss, a blemish is not attached to plating. Furthermore, since PTFE is distributed by plating, lubricity is also high. So, even if the surface roughness of the inner skin of a boss is somewhat large, a high sliding property is securable.
[0015] As for the base material of said sliding shaft, in this invention, being formed with stainless steel is desirable. That is, in a sliding shaft, if the substrate of nickel-Lynn plating is used as stainless steel, since the corrosion resistance of the base material of ******** can be raised, even if moisture should permeate the direction of a substrate from the pinhole of the nickel-Lynn plating which has covered the sliding shaft, rust is not generated in a base material. Therefore, in the plating which has covered the base material, since it can prevent that the float resulting from the rust of a substrate and peeling arise, the sliding property between the inner skin of a boss is maintainable in the good condition.
[0016] In this invention, said lens holder is formed with the liquid crystal resin which contained the carbon fiber 10 % of the weight to 40% of the weight. Moreover, nickel-Lynn plating which distributed PTFE 3 % of the weight to 11% of the weight is performed to the peripheral face of the base material of said sliding shaft.
[0017] In this invention, heat treatment is performed to the base material of said sliding shaft, and, as for Vickers hardness number Hv of the peripheral face of the base material concerned, it is desirable to have become 500 or more. Thus, if the degree of hardness of the peripheral face of the base material of a sliding shaft is raised, since plating thickness can be made thin and roundness and surface roughness can be improved, the sliding property and dependability of a sliding shaft can be improved. For example, even when the stress by the lens holder is applied to a sliding shaft, it can prevent that a sleeve trace occurs in the peripheral face of a sliding shaft.

[0018] Moreover, in order to secure sliding property sufficient between the bosses formed in the lens holder, it is desirable to set to 1.5 micrometers or less surface roughness of nickel-Lynn plating which distributed wrap PTFE for the peripheral face of the base material of a sliding shaft. Here, the surface roughness of nickel-Lynn plating which distributed PTFE is influenced of the surface roughness of the peripheral face of a base material. Then, in this invention, surface roughness of nickel-Lynn plating which distributed PTFE currently formed in the peripheral face of the base material of 0.4 micrometers or less, then said sliding shaft in the surface roughness of the peripheral face of the base material of said sliding shaft can be set to 1.5 micrometers or less.
[0019] As for the thickness of the nickel-Lynn plating which distributed the polytetrafluoroethylene currently formed in the peripheral face of the base material of said sliding shaft, in this invention, it is desirable that it is 1 micrometer - 4 micrometers. Thus, since there are 1 micrometers or more of thickness of plating at least when constituted, in order to raise a sliding property in plating, sufficient PTFE particle can be held. Moreover, since the thickness of plating is 4 micrometers or less, surface roughness of plating can be made small. Therefore, a high sliding property is securable.
[0020] As for Vickers hardness number Hv of nickel-Lynn plating which distributed the polytetrafluoroethylene currently formed in the peripheral face of the base material of said sliding shaft, in this invention, it is desirable that it is 500-600. Thus, or more with 500, if constituted, since Vickers hardness number Hv of plating is high, it can raise a sliding property. Moreover, Vickers hardness number Hv of plating does not damage 600 or less and the inner skin of the boss formed in the lens holder since it was not too high. What is necessary is to perform this plating to the peripheral face of the base material of a sliding shaft, and just to heat-treat after an appropriate time, in order to form the nickel-Lynn plating which distributed PTFE of such hardness.
[0021]
[Embodiment of the Invention] With reference to a drawing, the gestalt of operation of the objective lens driving gear of this invention is explained.
[0022] (Whole configuration) Drawing 1 is the top view showing the objective lens driving gear which applied this invention. Moreover, drawing 2 is a sectional view in the I-I' line in drawing 1 . As shown in drawing 1 and drawing 2 , the objective lens driving gear 1 has the lens holder 4 holding an objective lens 10, and the holder supporter material 2 which supported this lens holder 4.
[0023] The holder supporter material 2 is equipped with the bottom wall 22 of an abbreviation rectangle, and the side attachment walls 23-26 which started from the neighborhood of a bottom wall 22 perpendicularly. Adhesion immobilization of the tracking drive magnets 51 and 52 by which polarization magnetization was carried out in the hoop direction is carried out at the medial surface of the side attachment walls 23 and 24 mutually prolonged in parallel among these side attachment walls 23-26, respectively.
[0024] Moreover, from the bottom wall 22, the walls 27 and 28 of the pair prolonged in parallel to the side attachment walls 23 and 34 with which the tracking drive magnets 51 and 52 were attached are started. Adhesion immobilization of the focusing drive magnets 61 and 62 to which the inside is turned is carried out in the field magnetized by the single electrode at the medial surface of walls 27 and 28, respectively.
[0025] Furthermore, the sliding shaft 3 is being fixed to the center section of the bottom wall 22 inserted with the walls 27 and 28 of a pair. The lens holder 4 is supported by this sliding shaft 3.
[0026] The lens holder 4 is equipped with the cylinder-like drum section 43 and the bearing 44 of the shape of a cylinder formed the wrap top plate 41 and inside the drum section 43 in the drum section 43 bottom. The lens installation section 42 thinly jutted out towards an outside is formed in the top plate 41, and adhesion immobilization of the objective lens 10 is carried out on this. Moreover, on both sides of the bearing 44, the openings 411 and 412 of a pair are formed in the location of both sides among top plates 41.
[0027] The sliding shaft 3 which stood straight from the bottom wall 22 of the holder supporter material 2 is inserted in the boss 441 formed in the bearing 44 of this lens holder 4. Moreover, inside the openings 411 and 412 of the pair formed in the top plate 41 of a lens holder 4, the walls 27 and 28 of the

pair which stood straight from the bottom wall 22 of the holder supporter material 2 are inserted, respectively. Therefore, the bearing 44 of a lens holder 4 is arranged among the focusing drive magnets 61 and 62 attached in the walls 27 and 28 of a pair.

[0028] The focusing drive coil 63 is twisted around the bearing 44 of a lens holder 4. Between this focusing drive coil 63 and the focusing drive magnets 61 and 62, the focusing MAG drive circuit to which a lens holder 4 is moved up and down in accordance with the sliding shaft 3 is constituted.

[0029] Moreover, the tracking drive coils 53 and 54 of a pair are attached in the peripheral face of the drum section 43 of a lens holder 4 so that face to face may be stood against the tracking drive magnets 51 and 52. Between these tracking drive coils 53 and 54 and the tracking drive magnets 51 and 52, the tracking MAG drive circuit which rotates a lens holder 4 around the sliding shaft 3 is constituted.

[0030] The magnetic pieces 8 and 9 of a pair are also pasted up on the location which the tracking drive coils 53 and 54 of a pair pasted up among the peripheral faces of the drum section 43 of a lens holder 4. The center-valve-position maintenance means for holding a lens holder 4 in a center valve position to the holder supporter material 2 is constituted by the magnetic circuit between the magnetic pieces 8 and 9 of this pair, and the tracking drive magnets 51 and 52 of a pair. That is, magnetic attraction of the magnetic pieces 8 and 9 of a pair is carried out to the magnetic center position of the tracking drive magnets 51 and 52 of a pair. Therefore, when not supplying the current to the focusing drive coil 61 and the tracking drive coils 53 and 54, a lens holder 4 is held in the center valve position (center section of the direction of an axis of the sliding shaft 3) of the direction of focusing, and the center valve position (location where the tracking drive coils 53 and 54 stand face to face against the front of the tracking drive magnets 51 and 52) of the direction of tracking.

[0031] Moreover, the core of the magnetic pieces 8 and 9 of a pair is mutually shifted from the location which stands face to face against the magnetic core of the tracking drive magnets 51 and 52 of a pair to the circumference of the medial-axis line L of a boss 441 towards the direction where only the same include angle alpha approaches mutually. Therefore, since the magnetic-attraction force F1 and F2 of the tracking drive magnets 51 and 52 which work to the magnetic pieces 8 and 9 of a pair acts aslant towards the magnetic core of the tracking drive magnets 51 and 52, the lateral pressure F which turns and forces a lens holder 4 on the sliding shaft 3 according to resultant force of these magnetic-attraction force F1 and F2 generates it, respectively. Therefore, since the side on which lateral pressure F is acting among the inner skin of the boss 441 formed in the lens holder 4 has always stuck to the peripheral face of the sliding shaft 3, it is prevented with [of the lens holder 4 resulting from the path clearance between the inner skin of a boss 441, and the peripheral face of the sliding shaft 3] backlash.

[0032] (A lens holder 4 and sliding shaft 3) Here, the lens holder 4 is formed with the liquid crystal resin which contained the carbon fiber 10 % of the weight to 40% of the weight, in order to raise the rigidity and to prevent resonance. For this reason, the flexural modulus of a lens holder 4 is 35000 or more MPas in the part with a thickness of 8mm or more. However, although the carbon fiber is effective in order to raise the rigidity of a lens holder 4, there is a fault that the surface roughness of a lens holder 4 becomes large. Therefore, if it remains as it is, since the surface roughness of the inner skin of the boss 441 formed in the lens holder 4 is large, the sliding property of the inner skin of a boss 441 and the peripheral face of the sliding shaft 3 falls. So, with this gestalt, the sliding shaft 3 is formed so that it may explain below.

[0033] Drawing 3 is the sectional view of the sliding shaft 3. As shown in drawing 3 , the sliding shaft 3 has the round bar-like base material 31 and the plating layer 33 by which the laminating was carried out to the peripheral face 32 of this base material 31.

[0034] A base material 31 is formed with stainless steel. This base material 31 is processed so that the surface roughness of a peripheral face 32 may be set to 0.4 micrometers or less. Moreover, heat treatment is performed to a base material 31, and let surface hardness of the peripheral face 32 be 500 or more Vickers hardness numbers Hv.

[0035] The plating layer 33 is the nickel-Lynn plating which carried out distribution of the polytetrafluoroethylene (henceforth PTFE) 3 % of the weight to 11% of the weight (17 volume % - 27 volume %). The thickness dimension t of this plating layer 33 is 1 micrometer - 4 micrometers.

Moreover, the surface roughness of the peripheral face 34 of the plating layer 33 is 1.5 micrometers or less. The surface roughness of this plating layer 33 is influenced by the surface roughness of a base material 31. That is, since surface roughness of the peripheral face 32 of a base material 31 is set to 0.4 micrometers or less, if the thickness dimension of the plating layer 33 which carries out a laminating to the peripheral face 32 of this base material 31 is 4 micrometers or less, surface roughness of the peripheral face 34 of the plating layer 33 can be set to 1.5 micrometers or less. Furthermore, heat treatment is performed to the plating layer 33. Consequently, the surface hardness of the peripheral face 34 of the plating layer 33 serves as Vickers hardness number Hv 550 [about].

[0036] Such a plating layer 33 of the sliding shaft 3 can be formed so that it may explain below. Namely, as shown in drawing 4 , it rinses by performing preliminary cleaning of the base material 31 with which heat treatment was performed beforehand (step ST 1) (step ST 2). Next, it rinses by performing boiling cleaning of a base material 31 (step ST 3) (step ST 4). Next, it rinses by performing electrolytic degreasing of a base material 31 (step ST 5) (step ST 6). Next, it rinses by performing pickling of a base material 31 (step ST 7) (step ST 8).

[0037] Thus, nickel strike plating is performed and (step ST 9) rinsed to the peripheral face 32 of the washed base material 31 (step ST 10). This is for raising the adhesion of the nickel-Lynn plating which distributed the following PTFE.

[0038] Next, non-electrolyzed nickel-Lynn plating which made the peripheral face 32 of a base material 31 distribute PTFE is performed (step ST 11). Consequently, the peripheral face 32 of a base material 31 is covered in the plating layer 33.

[0039] After an appropriate time, centrifugal hydroextraction of rinsing (step ST 12), hot water rinsing (step ST 13), and the pure-water washing (step ST 14) is performed and carried out (step ST 15).

[0040] At the end, it heat-treats (step ST 16) and the surface hardness of the plating layer 33 is raised.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view showing the objective lens driving gear of this invention.
[Drawing 2] It is a sectional view in the I-I' line of drawing 1 .
[Drawing 3] It is the sectional view showing the sliding shaft of the equipment shown in drawing 1 .
[Drawing 4] It is the flow chart which shows how to form a plating layer to the base material of a sliding shaft.
[Drawing 5] The approach shown in drawing 4 is a flow chart which shows how to form a plating layer to the base material of a sliding shaft by the option.
[Description of Notations]
1 Objective Lens Driving Gear
2 Holder Supporter Material
3 Sliding Shaft
4 Lens Holder
10 Objective Lens
31 Base Material
32 Peripheral Face of Base Material
33 Plating Layer
34 Peripheral Face of Plating Layer
51 52 Tracking drive magnet
53 54 Tracking drive coil
61 62 Focusing drive magnet
63 Focusing Drive Coil
441 Boss

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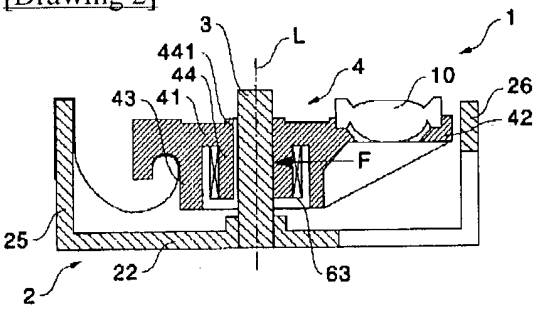
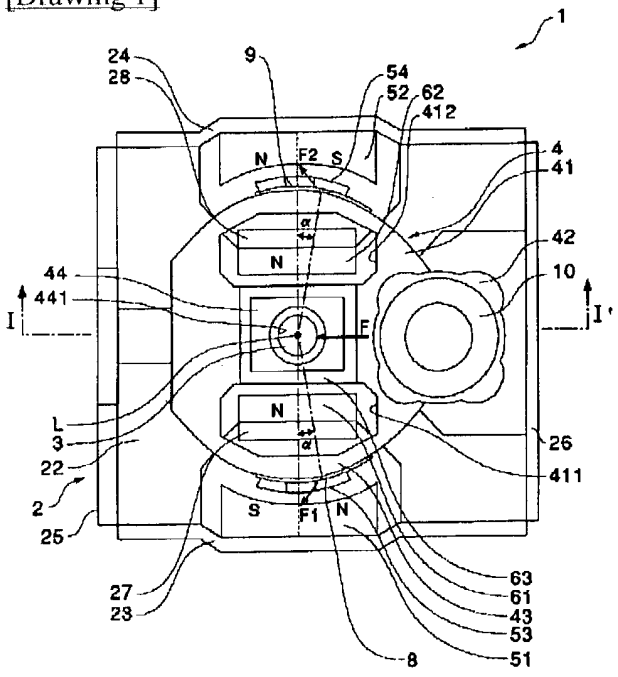
DRAWINGS

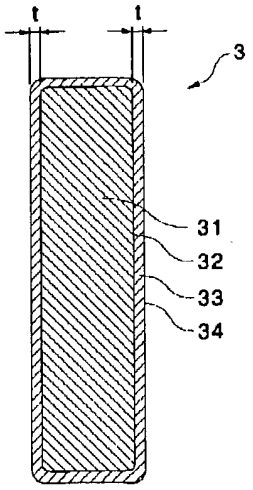
[Drawing 2]



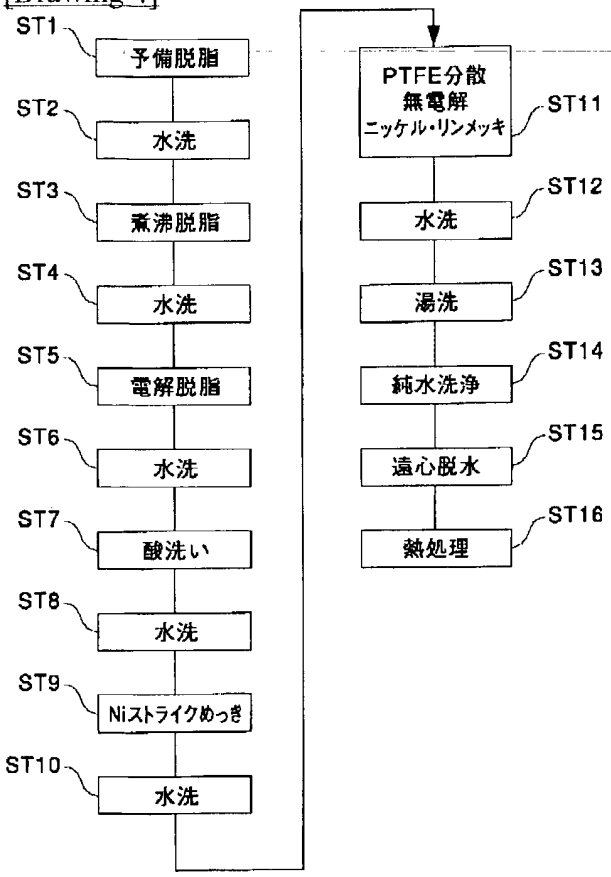
[Drawing 1]



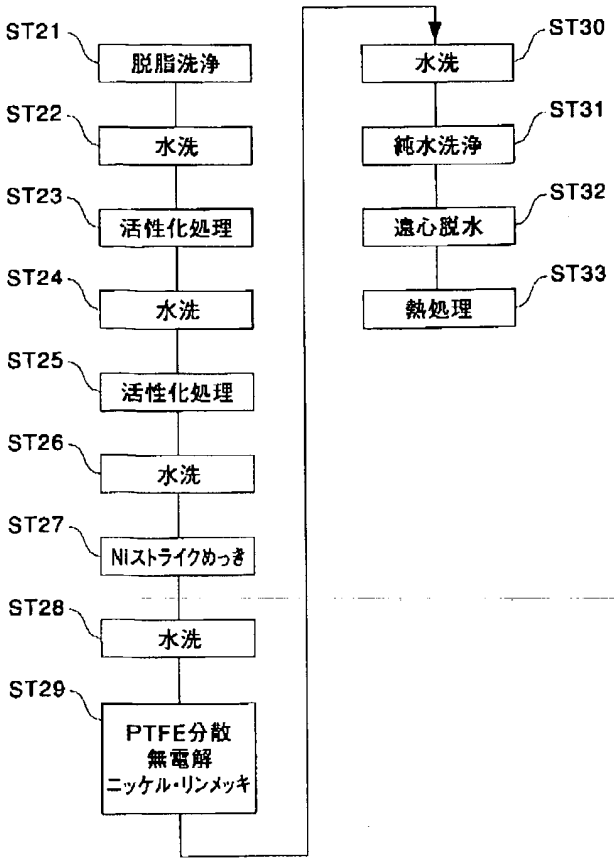
[Drawing 3]



[Drawing 4]



[Drawing 5]



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